5. NEWTON'S LAWS OF MOTION

1. From third law of motion

$\vec{F}_{AB} = -\vec{F}_{BA}$ $\quad \vec{F}_{AB}$ = Force on A due to B $\quad \vec{F}_{BA}$ = Force on B due to A

2. From second law of motion

$F_x = \frac{dP_x}{dt} = ma_x \quad F_y = \frac{dP_y}{dt} = ma_y \quad F_z = \frac{dP_z}{dt} = ma_z$

5. WEIGHING MACHINE :

A weighing machine does not measure the weight but measures the force exerted by object on its upper surface.

6. SPRING FORCE $F = -kx$

x is displacement of the free end from its natural length or deformation of the spring where K = spring constant.

7. SPRING PROPERTY K ℓ = constant
= Natural length of spring.

8. If spring is cut into two in the ratio m : n then spring constant is given by

$\ell_1 = \frac{m\ell}{m+n}; \quad \ell_2 = \frac{n.\ell}{m+n} \quad k\ell = k_1\ell_1 = k_2\ell_2$

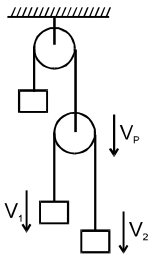
For series combination of springs $\frac{1}{k_{eq}} = \frac{1}{k_1} + \frac{1}{k_2} + ...$

For parallel combination of spring $k_{eq} = k_1 + k_2 + k_3$ .....

9. SPRING BALANCE:

It does not measure the weight. It measures the force exerted by the object at the hook.

Remember :

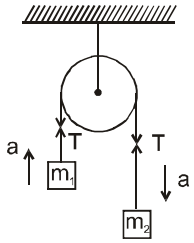


$V_P = \frac{V_1 + V_2}{2}$

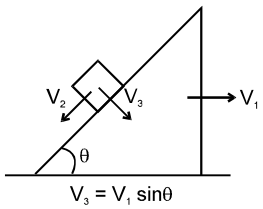
$a_P = \frac{a_1 + a_2}{2}$

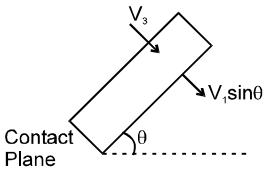
11. $a = \frac{(m_2 - m_1)g}{m_1 + m_2}$

$T = \frac{2m_1m_2g}{m_1 + m_2}$



12. WEDGE CONSTRAINT:





Components of velocity along perpendicular direction to the contact plane of the two objects is alway equal if there is no deformations and they remain in contact.

13. NEWTON S LAW FOR A SYSTEM

$\vec{F}_{ext} = m_1a_1 + m_2a_2 + m_3a_3 + ...$

F_{ext} = Net external force on the system.

m_1, m_2, m_3 are the masses of the objects of the system and

a_1, a_2, a_3 are the acceleration of the objects respectively.

14. NEWTON S LAW FOR NON INERTIAL FRAME :

$$\vec{F}_{Real} + \vec{F}_{Pseudo} = m\vec{a}$$

Net sum of real and pseudo force is taken in the resultant force.

a = Acceleration of the particle in the non inertial frame

$$F_{Pseudo} = - m\ a_{Frame}$$

(a) Inertial reference frame: Frame of reference moving with constant velocity.

(b) Non-inertial reference frame: A frame of reference moving with non-zero acceleration.